City Burlington

Echo Lake Dam

Field File No. 51.01
Key Sequence No. 602
Walworth County, Wisconsin

Prepared for:

City of Burlington

August 2017

August 8, 2017

Burlington, WI

Re: Post Flood
Dam Safety Inspection Report

Dear Mr. :

Ayres Associates completed an inspection of the Echo Lake Dam on August 3, 2017, in accordance with Wisconsin Department of Natural Resources (WDNR) guidelines. The purpose of this inspection was to assess the condition of the dam following the July floods. We did not review the emergency action plan, operation plan or dam failure analysis. These reviews are still required to satisfy the Owner Responsible Inspection. The following list describes our observations and provides recommendations. Please note that dam structures are referenced from left to right while looking in a downstream direction.

Dam Description and Inspection

The Echo Lake consists, looking left to right, an earthen embankment, a gated spillway with one Tainter gate and a 250 long auxiliary concrete ogee spillway that ties into the railroad embankment. For purposes of this inspection we called the fixed crest spillway the auxiliary spillway. To our knowledge the fixed crest spillway only has flow over it in periods of higher runoff, otherwise most flow is passed through Tainter gate spillway.

This inspection was completed by walking the embankment areas, walking along the top and bottom of the auxiliary spillway and probing under accessible areas of the dam with a survey rod. The entire toe of the auxiliary spillway was probed from the bottom of the spillway. The gated spillway was probed from the left bank and from the right side form the platform above the spillway.

Inspection Findings

1. Embankment Section

   The embankment section of the dam did not over top during the July flood. Sediment stains are present, as noted in attached photographs, which show the highwater mark on the embankment. The embankment is in good condition with no observed seepage, rodents, trees, brush or erosion concerns.

2. Tainter Gate Spillway

   The Tainter gate was opened during the flood and remained open during this inspection. The gate and operator are relatively old and the City is considering replacing the gate. It

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does appear to have functioned property during the flood and did not sustain any damage.

The downstream spillway was probed to check for scour and undermining. We measured about a 3 foot drop from the edge of the concrete apron of the spillway to the riprap below. We probed under the apron and did not measure any undermining. It appears that some riprap may have been displaced immediately below the spillway and this should be replaced with WisDOT classified heavy riprap.

We also probed along the left training wall and riprap in this area was not displaced.

3. Auxiliary Spillway

The Auxiliary spillway consists of two different shaped sections. The far left end the spillway drops off vertically without an ogee shape. In this area the amount of vertical scour was up to four feet deep (see photo). The majority of the spillway has an ogee shape and in these areas riprap is still at the toe of the spillway base.

We did walk the spillway and probed with the survey rod and noted several areas where the spillway is undermined up to 2 feet, with most areas being about 12 inches.

4. Sidewalk Scour

The sidewalk leading up to the dam suffered scour along the left side. This can be repaired by refilling the area with compacted soil and seeding.

Recommendations

It appears that overall the Echo Lake dam withstood the flood with minimal damage. The displaced riprap and sidewalk scour can be repaired and are typical of routine maintenance required post flood. The undermining noted is likely not a result of this recent flood, but more a long term chronic problem. If the spillway continues to undermine the stability could be compromised and the City should consider grouting the downstream side of the spillway to halt this undermining.

Spillway capacity also is an issue. The dam failure analysis indicates that this dam does not have capacity to pass the 500 year flood. The City should investigate options to increase spillway capacity to pass the 500 year flood.

Please let us know if we can be of further assistance to you.

Sincerely,

Ayres Associates Inc

Christopher T. Goodwin, PE
Manager - Water Resources
Direct: 715.831.7682
Goodwinc@AyresAssociates.com

cc: Andrea Stern, WDNR
Greg Governatori

Name of Dam:	Burlington Echo Lake Dam	**Date:**	8/3/2017
Inspectors:	Chris Goodwin, PE	**F.F #:**	51.01
Owner's Name:	City of Burlington	**Key Seq #:**	602
Street:	2200 S. Pine Street		
City, State, Zip Code:	Burlington WI		
County:	Racine	Owner's Phone:	262.342.1181
Weather and Site conditions:	77F and Cloudy	Email:	

GENERAL

	Item	N	P	Notes/ Observations	Action M	Action I	Action R
1	**Monuments/Benchmarks**	x					
	Location:			Chiseled X US LT Abutment Wall Adj to Gate			
	Elevation:			Unknown			
	Datum:			Unknown			
2	**Pool Level**						
	Normal/Operating:			Lowered post flood, gate fully open			
	Maximum:			none			
	Minimum:			none			
	Staff Gage						
3	**Access Road**	x					
				Though City Park			
4	**Signage/ Security**						
	Portage/route:						
	Dam Warning:	x					
	Downstream Hazard:			local fishing downstream			
	Fencing/Railings/Catwalks:			Good			

Additional Comments:

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Action Suggestion 1. Requires immediate action
2. Plan to do soon
3. Do when convenient

GENERAL (Cont.)

5 Hazard Section

A. D/S Development	
Density:	Dense
Distance:	
Type (Residential, Commercial, Industrial):	Commercial
B. Channel Crossing	
Type:	Bridge
Dimensions:	
D/S distance:	425
Traffic Level (Local, CTH, Rail Road, STH, Interstate, etc):	STH
C. Distance to nearest D/S community/impoundment:	Burlington
Name:	
D. Anticipated Hazard (based on landuse and zoning):	Significant
E. Dam Failure Analysis	
Date Completed/Approved	Jul-15
Is map available?	
Are map & profile adopted?	
List adoption date:	
Verify validity of failure mode:	
Verify validity of DFA conclusions:	

F. Emergency Action Plan	Y	N	Comments, Explanation, and Description	M	I	R
1. Current plan posted?	x					
2. Understood by Operator?	x					
3. Warning systems?						
4. Certification of last test?						
5. Remote operation?						
6. Revision Date?						
7. Habitable structures?	x					
8. Recreation areas?	x					
9. Changed hazard potential?						
10. New development?						
11. Other comments?						

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EMBANKMENTS

Description:

	Item	N	P	Location on Embankment and Deficiency	Action M	Action I	Action R
1	**Vegetation:**	X		No problem			
	A. Trees Quantity (<5,sparse,dense): Diameter: Location:						
	B. Brush Quantity (sparse,dense): Location:						2
	C. Ground cover Type (grass, crown vetch,other): grass Quantity (bare, sparse,adequate, dense): adequate Appearance (too tall, too short, good):						
2	**Erosion**	x		No problem / Not applicable / Could not inspect			
	A. Wave erosion (Beaching): Scarp: Length/ Width: Location:						
	B. Runoff Erosion (Gullies) Quantity: Length/ Width/ Depth: Location:						
3	**Instabilities**	x		No problem / Not applicable / Could not inspect			
	A. Slides Transverse: Longitudinal: Scarp: Length/ Width: Crack Length/ Width:						
	B. Cracks: Transverse: Longitudinal: Length/ Width/ Depth: Location: Other:						
	C. Bulges/ Depressions Size: Height/ Depth:						
	D. Slope (Too Steep) U/S, D/S						

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Additional Comments:

EMBANKMENTS (Cont.)

	Item	N	P	Notes/ Observations	Action M	Action I	Action R
4	**Slope Protection**	x		No problem ☐ Not applicable ☐ Could not inspect			
	A. Type (none, riprap, wave berm, concrete slabs, loose formed concrete/asphalt):						
	B. Condition:						
5	**Other**	x		No problem ☐ Not applicable ☐ Could not inspect			
	A. Rodent burrows (few, many)						
	Location:						
	B. Ruts						
	Length/ Width/ Depth:	none seen					
	Location:						
	C. Other						
6	**Alignment**	X		No problem ☐ Not applicable ☐ Could not inspect			
	A. Vertical						
	Low area:						
	Elevation Difference:						
	Location:						
	B. Horizontal						
	C. Width						
	Too narrow:						
	Location:						
7	**Toe**	x		No problem ☐ Not applicable ☐ Could not inspect			
	Cracks/Slumps:						
	Embankment drains:						
	Type/Flow:						
	Location:						
	Seepage/ Wetness:						
	Hummocky:						
8	**Seepage**	X		No problem ☐ Not applicable ☐ Could not inspect			
	Wet area:			not seen			
	Boil:			not seen			
	Sinkhole:			not seen			
	Aquatic vegetation:			not seen			
	Rust colored deposits:			not seen			
	Other:						
	Sediment in Flow:			not seen			
	Flowrate:						
	Location:						

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Additional Comments:

SPILLWAY--PRINCIPAL - FIXED CREST					Action		
	Item	N	P	Notes/ Observations	M	I	R
1	**Fixed Crest**	x		No problem ☐ Not applicable ☐ Could not inspect			
	A. Dimensions Top Width:			250 feet long			
	B. Materials			Concrete			
	C. Shape (sharp-crested, broad-crested, ogee, chute, gated, overflow, morning glory, dropbox, labyrinth)			Ogee			
	D. Debris Prevention (racks, booms, etc.):			Minimal			
	E. Concrete Condition *			Adequate for age			
	F. Flashboards (none, number): Type (Metal, wood): Dimensions: Operability:			none none none			
	G. Abutments Condition: * Seepage/wetness:			Fair, some spalling. LT abutment is old mill building and gate. RT is railroad grade none ovserved			
	H. Drains Type: Weep holes, Relief drains, Other:_____ Flow Rate:			☐ No problem ☐ Not applicable ☐ Could not inspect none noted	1		
	I. Other						

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Action Suggestion
1. Requires immediate action
2. Plan to do soon
3. Do when convenient

Controlled = Gated
Uncontrolled = Overflow

Additional Comments:

* **Type of Concrete Problems:** Spalling, cracks, exposed rebar, misalignment, joints, bug holes, efflorescence, popouts, honeycombing, scaling, craze/map cracks, isolated crack, disintegration, other

SPILLWAY-PRINCIPAL - GATES					Action		
Item	N	P	Notes/ Observations		M	I	R
1 Gates		No problem	x	Not applicable		Could not inspect	
A. Types (lift/slide, tainter(radial), stoplogs, leaf, roller, flashboards, needles, other): Number and Size:			One Tainter gate that is fully open during inspection				
B. Stoplogs Dimensions: Condition:			none				
C. Abutments Condition: *			Fair				
Seepage/wetness:			Could not inspect due to full flow through gate opening.				
D. Piers (number, shape) Condition: *			none				
E. Operability Type of Operator:			Crank with cables				
Condition(chain, cables,hoists):			Fair				
Security(locked?):			access restricted an locked				
Backup Operator:							
F. Access			Good				
G. Condition Rust:			Gate is scheduled for replacement.				
Seals (leakage):							
H. Ice protection Type (Heaters, Bubblers, Barriers, Other)			none				
I. Debris Prevention (Rack, boom, etc.)			none				
J. Condition of Flowway			good concrete, but much was underwater				
K. Drains Type (Weep holes/ Relief drains/ Other):			could not be inspected due to flow (if present)				
Flow rate:							
Location:							
L. Other							

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Action Suggestion **1.** Requires immediate action
2. Plan to do soon
3. Do when convenient

Controlled = Gated **Uncontrolled** = Overflow

Additional Comments and/or Sketch:

* **Type of Concrete Problems:** Spalling, cracks, exposed rebar, misalignment, joints, bug holes, efflorescence, popouts, honeycombing, scaling, craze/map cracks, isolated crack, disintegration, other

SPILLWAY--PRINCIPAL - OUTLET EROSION CONTROL & UNDERMINING

	Item	N	P	Notes/ Observations	Action M	Action I	Action R
1	**Outlet Erosion Control**			No problem ☐ Not applicable ☐ Could not inspect			2
	A. Type (none, endwall, plunge pool, energy dissipation structure rock lined channel, apron)			Riprap channel			
	B. Scour			yes, 3' at end of apron, none noted under LT wall			
	C. Material						
	a. Riprap: Avg Diameter:			24"			
	Condition (adequate, sparse, displaced, weathered):			displaced			
	Bedding fabric- (Yes/ No):						
	b. Concrete *						
	Dimensions/Location:			no			
	D. Sidewall/Headwall						
	Misalignment:			LT Side wall, probed and no undermining and riprap at toe.			
	Location:						
	Description:						
	E. Separated Joint / Loss of Joint Material:						
	Location:			not seen			
	Description:						
	F. Natural						2
2	**Undermining**	x		No problem ☐ Not applicable x Could not inspect			
	Location:						
	Description:			Probed under apron and no undermining			

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Action Suggestion
1. Requires immediate action
2. Plan to do soon
3. Do when convenient

Controlled = Gated **Uncontrolled** = Overflow

Additional Comments:

* **Type of Concrete Problems:** Spalling, cracks, exposed rebar, misalignment, joints, bug holes, efflorescence, popouts, honeycombing, scaling, craze/map cracks, isolated crack, disintegration, other

SPILLWAY--AUXILIARY

Description:

	Item	N	P	Notes/ Observations	Action M	I	R
1	**Dimensions**	x					
	Length/ Width:	250'					
	Outfall Slope:						
2	**Type** (turf, reinforced turf,	x					1
	riprap, block, concrete):	Concrete Ogee					
3	**Signs of usage**	x					
	(debris, bent grass, etc.):	Flowed in July flood					
4	**Vegetation:**	x		No problem			
	A. Trees				1		
	Quantity (<5, sparse, dense):						
	Diameter:						
	Location:						
	B. Brush						
	Quantity (sparse, dense):						
	Diameter:						
	Location:						
	C. Ground cover:						
	Type (grass, crown vetch, other)						
	Quantity (bare, sparse, adequate dense):						
	Appearance (tall, short,good):						
5	**Slope protection**			Not applicable			
	A. Type (none, riprap, wave						
	berm, concrete slabs, other):						
	Condition:						
6	**Erosion**	x		No problem / Not applicable / Could not inspect			
	A. Wave erosion (beaching):						
	Scarp: Length/ Width:						
	Location:						
	B. Runoff erosion (Gullies)						
	Quantity:						
	Length/ Width/ Depth:						
	Location:						
7	**Instabilities**	x		No problem / Not applicable / Could not inspect			
	A. Slides						
	Transverse Length:						
	Longitudinal Length:						
	Scarp: Length/ Width:						
	Location:						
	Crack Length/ Width:						
	Location:						

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Action Suggestion
1. Requires immediate action
2. Plan to do soon
3. Do when convenient

Additional Comments:

*** Type of Concrete Problems:** Spalling, cracks, exposed rebar, misalignment, joints bug holes, efflorescence, popouts, honeycombing, scaling, craze/map cracks, isolated crack, disintegration, other

	SPILLWAY--AUXILIARY (Cont.)					Action		
	Item	N	P	Notes/ Observations		M	I	R
	B. Bulges: (Depressions, Hummocky):							
	Size:	none seen						
	Height/ Depth:							
8	**Other**	x	No problem	Not applicable	Could not inspect			
	A. Rodent burrows (few, many)					3		
	Location:							
	B. Ruts							
	Location:	none seen						
	Length/ Width/ Depth:							
	C. Other (debris):							
9	**Outlet erosion control**		No problem	Not applicable	Could not inspect thoroughly			
	A. Type (none, endwall, plunge pool, energy, dissipation structure rock-lined channel, apron):	Riprap at toe of bottom of ogee						
	Condition (Scour?):							
	B. Material							
	Riprap: Avg. diameter:	24" riprap						
	Condition (adequate, sparse, displaced, weathered):	The far LT end of ogee is more vertical than sloped. In front of vertical areas measured 4' deep scour. Along rest of ogee, no vertical scour, but several areas where spillway is undermined maximum of 2'.						
	Bedding fabric (Yes/No):							
	C. Concrete *	x						
	a. Condition *		Good					
	b. Cracking *		none apparent					
	Dimensions/Location:							
	c. Sidewall/ Headwall*		some spalling					
	Misalignment:							
	Location:							
	Description:							
	d. Joints							
	Separated:							
	Loss of material:							
	Location:							
	Description:							
	D. Natural							
10	**Undermining**	x	No problem	Could not inspect thoroughly				
	Location:							
	Description:							

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Inspection Echo Lake Dam (Key Sequence No. 602)
August 3, 2017

Burlington Echo Lake Dam
Photo During Flood (Taken July 25)

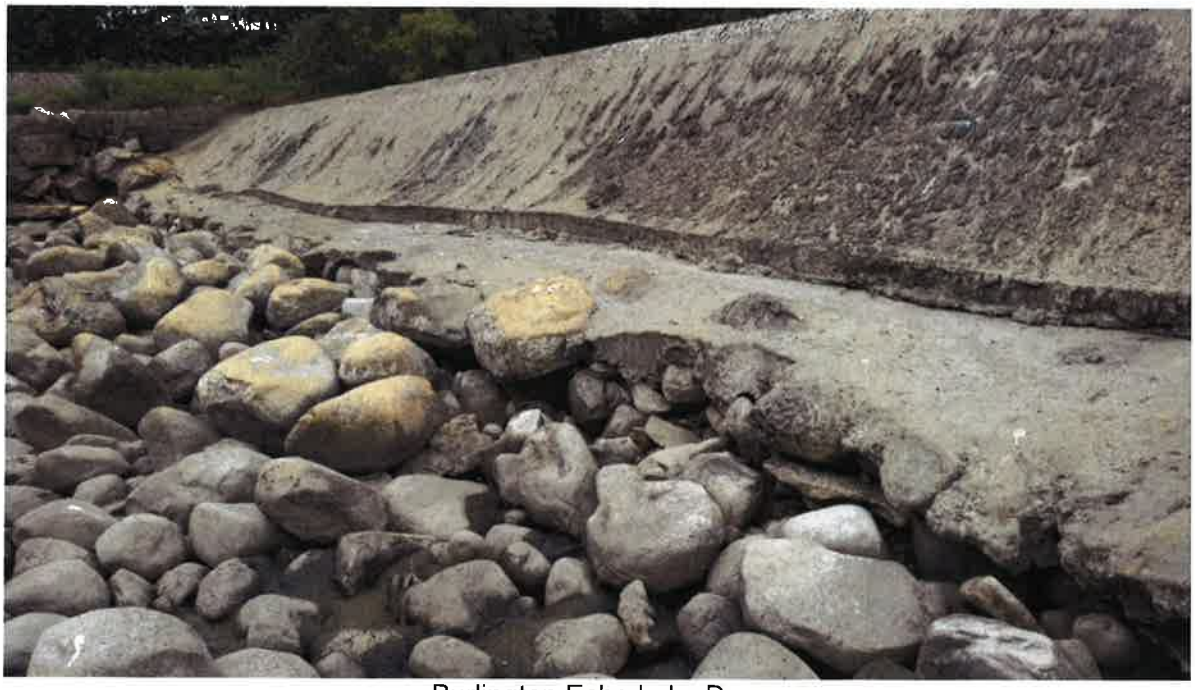
Burlington Echo Lake Dam
Auxiliary spillway viewed from left

Burlington Echo Lake Dam
Auxiliary spillway near vertical section

Burlington Echo Lake Dam
Auxiliary spillway near vertical section

Burlington Echo Lake Dam
Auxiliary spillway from viewed from right

Burlington Echo Lake Dam
Typical undermining of 1 foot under spillway



Burlington Echo Lake Dam
Spillway undermining

Burlington Echo Lake Dam
Embankment